Stream Crossing Quality Index (SCQI) Survey
Horsefly Watershed
Watershed Assessment Update for
Eight Watershed Tributary to the Horsefly River

1. METHODOLOGY

1.1 General Concept

The SCQI is based on the concept of the stream crossing density index used in the Watershed Assessment Procedure (WAP) (Government of BC, 1999). The assumption in the WAP is that the risk to water quality increases as the density of stream crossings within a watershed increases. The stream crossing density index assumes that every crossing is a problem from the point of view of erosion and sediment delivery. Although this is a useful index to highlight potential for cumulative effects problems, it does not consider the actual quality of erosion and sediment control (ESC) or de-activation measures that may have been implemented at a particular stream crossing. Consequently, the numerical value of such an index will always increase with increasing activity within a watershed. Thus, such an index cannot evaluate progress towards the achievement of a specified goal, this being an explicit requirement of many forest management certification schemes (e.g. CSA). Consequently, it is necessary to develop an index that will document and evaluate problems as well as successes. The index must provide an incentive to improve practices by documenting those practices that achieve the desired goals. The SCQI was designed to be such an index.

The SCQI is based on the concept that the impact of stream crossings on water quality can be reduced through effective erosion and sediment control practices, and that this can be evaluated and scored. As with the stream density index, each crossing within a watershed is, at priori, assumed to be having a negative impact on water quality. However, the negative value of this stream crossing can be reduced if the crossing is evaluated and not showing any signs of erosion and sediment transport. Thus a crossing that shows problems receives a value or score of one (1). As the quality of a crossing improves, the score is reduced, eventually reaching zero (0). This can effectively eliminate the crossing from the “erosion and sediment producing” inventory. As the scores for the individual crossings are reduced so is the SCQI for that watershed. This mechanism provides an incentive to implement good ESC measures. Table 1 provides a simple example of the SCQI concept.

Table 1. Example calculation of Stream Crossing Quality Index (SCQI) for Bogus Watershed (size = 30km^2)

Culvert ID	Field comments	Score	Sum of score
#1	Severe problems	1	
#2	No erosion	0	
#3	Severe erosion	0.9	
#4	Mild erosion	0.2	
#5	Moderate problems	0.7	
#6	De-eactivated and stable	0.1	
#7	Severe problems	1.0	
#8	Moderate erosion	0.5	
#9	Slight erosion	0.2	
#10	Extensive erosion	0.8	
Equivalent Stream Crossing Number =			5.4

Stream crossing density = 10/30 km^2 = 0.33 crossings/km^2
The SCQI score for the Bogus watershed = 5.4/30km^2 = 0.18 crossings/km^2

1.2 Survey Planning

For individual small watersheds that have undergone a preliminary overview watershed assessment (range of 50 km^2), it is recommended that every stream crossing within the watershed be assessed in the field. This will provide a 100% field survey. However, for large areas, with numerous sub-basins (such as TFL #30, TFL #48 or the Houston operating area), a 100% sampling scheme is usually not feasible. In these cases a sub-sampling scheme must be used. The details for designing an appropriate sub-sampling scheme can be tailored for specific needs and can be developed for the SFM and SFI initiative of interest. The sub-sampling scheme must consider and sample a variety of road segments and stream crossings based on the following list of criteria:

1. stream size (i.e. both large and small streams)
2. terrain types (i.e. flat, slope, mountainous and steep terrain)
3. soil types (e.g. lacustrine, glacio-fluvial, tills, etc)
4. age of road (e.g. abandoned, old, and new)
5. level of road use (e.g. de-activated, low use, active mainline)
6. stream crossing structures (e.g. bridges, CMP, de-activated)
7. road gradient

The objective of the sampling scheme will be to sample enough road segments and stream crossings (number yet to be determined) so that an assessment can be made about the general quality of the streams crossings for a large variety of crossings types (within a given DFA).

It is important to note that the SCQI method was designed to be quick (less than 10 minutes per crossing) so that a maximum number of crossings can be assessed. The SCQI is a subjective type of assessment, yet it is systematic in it's approach. There are no quantitative measures that must be made (e.g. length and depth of erosion rills). The SCQI was designed with the assumption that it is better to assess a much larger number of crossings in a qualitative way, than it is to assess few crossings in a very detailed way (the detailed measurements are achieved through the intensive water quality monitoring program).

To maintain the efficiency of the SCQI methodology, it is important that all of the stream crossings along a "selected" road segment be sampled and that adjacent road segments be sampled consecutively. It would be non-productive to select a random series of stream crossings across the landscape and visit them according to the order of the random selection. This would result in too much driving and very little sampling.

1.3 Individual crossing scores

For the purposes of the SCQI objectives, the stream crossing scores are analysed both on an individual basis and collectively for a watershed. Individual stream crossing scores can be used to identify problem areas or unique problem sites. The collective (or watershed scores) can be used as an overall index of the potential for water quality problems within a given watershed (or landscape unit). This type of index is required for many forest certification schemes (e.g CSA). An example of how individual scores can be added up to create a watershed score for a particular watershed is provided in Table 1.

1.4 Field Sampling

After a sampling scheme has been determined and individual road segments identified, then the field sampling begins. The survey focuses on evaluating the potential of sediment delivery at each of the stream crossings. The evaluation includes assessing erosion from cutbanks, ditches and road running surfaces that flow to a stream crossing and then estimating the potential of delivery of the eroded material to the stream network. It is assumed that the delivery of this kind of material to the stream would constitute a reduction in water quality. The field sampling must be completed under complete snow-free conditions. It is actually preferable (although miserable) to complete these surveys during rainy and wet conditions. This will allow the surveyor to "see" the actual quality of the stream crossing from the perspective of erosion and sediment delivery. If the crossing is bad there should be a visible difference between turbidity of the water above and below the stream crossing.

In order to access all of the road segment types that may be required to provide a complete picture of the quality of the stream crossings with a designated DFA it will be necessary to travel the roads with a variety of access vehicles. This will include 4x4 trucks, 4X4 ATV's, walking and possibly the use of helicopters.

At each of the stream crossings the information provided in the list below should be collected . Although the main focus of this survey is to assess erosion and sediment delivery at stream crossings, some additional information about the crossing are collected and are useful for sorting and classifying the data.

1. Sub-basin name
2. Mapsheet #
3. Crossing ID
4. UTM Easting
5. UTM Northing
6. Structure Type
7. Size of culvert or opening
8. Erodibility of road running surface (by class)
9. Level of road use (by class)
10. Erosion level of the road running surface (score of 0 to 1)
11. Sediment delivery potential of the road erosion (score of 0 to 1)
12. Erosion level for each of the four ditches (score of 0 to 1)
13. Sediment delivery potential for each of the four ditches (score 0 to 1)
14. Width of the stream channel by class size
15. Stream gradient by class size
16. Percentage of structure plugged
17. Level of concern for fish passage
18. Functional condition of the structure (culvert or bridge) to pass water and sediments
19. Other comments

An example of the field data form is provided in as an attachment to this document. An explanation of the classification system is also provided.

1.5 Reporting

The final report of the SCQI survey will contain all of the field data forms along with the individual scores for each of the crossings. The scores will then be tallied up to provide an overall SCQI for the entire sub-basin or landscape unit. This will provide field based index of water quality problems associated with forest harvesting operations for the DFA or watershed. Data can also be sorted and analysed by various variables included in the database, such as stream size, stream gradient or crossing type.

The report will include detailed maps for each sub-basin identifying each of the stream crossings that were assessed. The assessed stream crossings will be colour coded to help visualize the results (e.g. red star for high hazard, yellow star for moderate hazard, green star for low hazard and blue star for no concern). A digital map file of all of the crossings and the associated databases can also be provided.

1.6 General Philosophy of SCQI Approach

The SCQI procedure does not in any way consider the natural condition of the stream or it's ecological value. Every stream is considered the same and has the same value. Everyone may not agree with this concept, but that is the way we complete the SCQI. The basic premise of the SCQI philosophy is that erosion and sediment generated by roads at stream crossings is something that can be controlled by the licensee or operator. If we control this sediment source to a reasonable level then roads (which are the responsibility of the land manager –govt or licensee) will not be affecting the stream's fine sediment budget (whatever that is). If we control the input of fine sediment at stream crossings, then we don't have to get into the situation where we argue about the natural sediment regime, which is always difficult to evaluate. The SCQI considers that all streams should be protected in the same way. Using this philosophy, we know that there will not be downstream cumulative impacts. It is true that some streams may be less sensitive than others to the input of fine sediment, but how do you determine this for every stream in the field. I do not think that the SCQI states that you must get a score of 0.0 for your watershed, but that sediment sources should be controlled to the best of your ability. Maximum target scores could be established relative to an acceptable level of risk that is determined in conjunction with agencies. This is how it is being used by Canfor for their certification process (i.e. they are setting maximum target values for each watershed and the target is NOT 0.0).